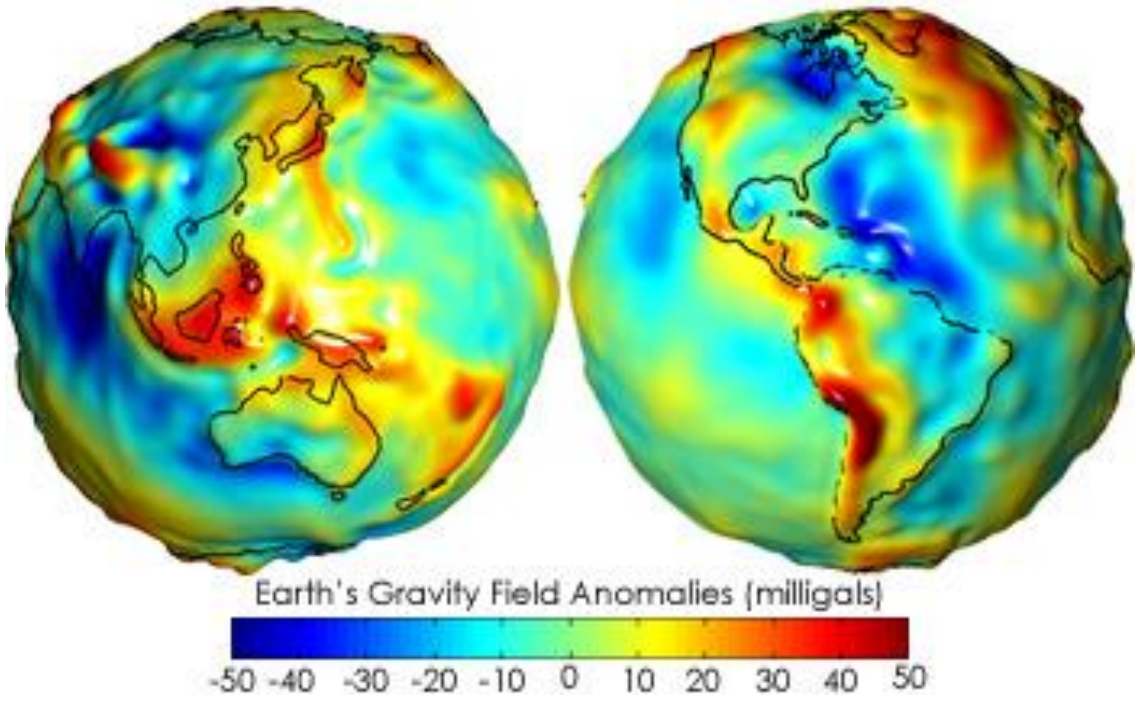
California's Epic Drought as Viewed from Space

Jay Famiglietti
NASA Jet Propulsion Laboratory, California Institute of Technology
Tom Painter
NASA Jet Propulsion Laboratory, California Institute of Technology
Matt Rodell
NASA Goddard Space Flight Center

2014 AGU Fall Meeting, Press Conference, December 16

Photo by Allen Schaben for the Los Angeles Times

Geodetic sensors measure Earth's shape and gravity field



Key results reported today

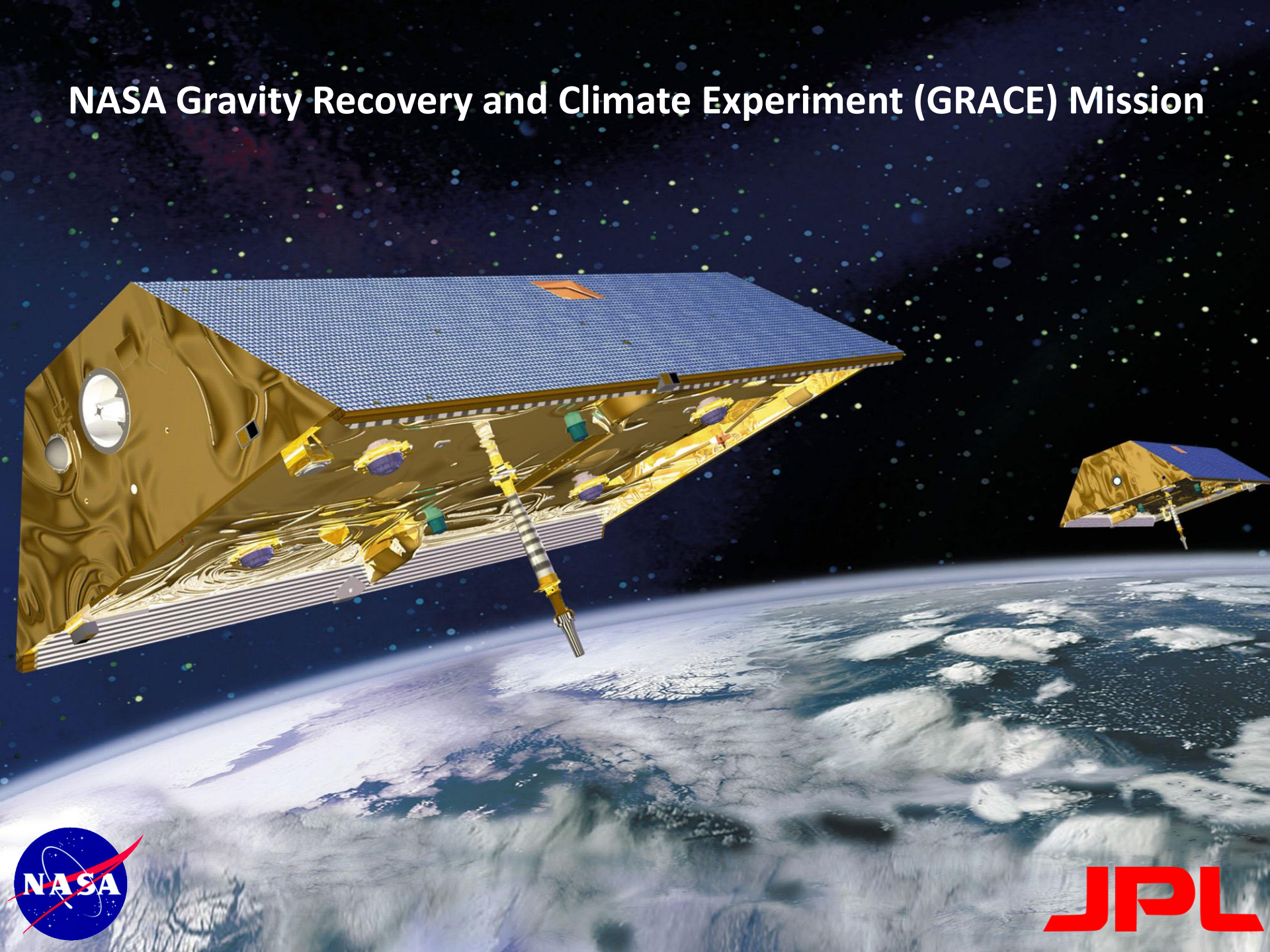
- New 'Total Water Storage Deficit' drought analysis using NASA GRACE mission can now quantify beginning, end and magnitude of drought
  - *Peak Total Water Storage Deficit in California drought is 42 km^3 in 2014, nearly 1.5 times the volume of Lake Mead*

- NASA's Airborne Snow Observatory (ASO) is providing first high-resolution snowpack measurements in mountainous regions
  - *Shows previous measurements of snowpack are off by a factor of 2 in California's Sierra Nevada range*

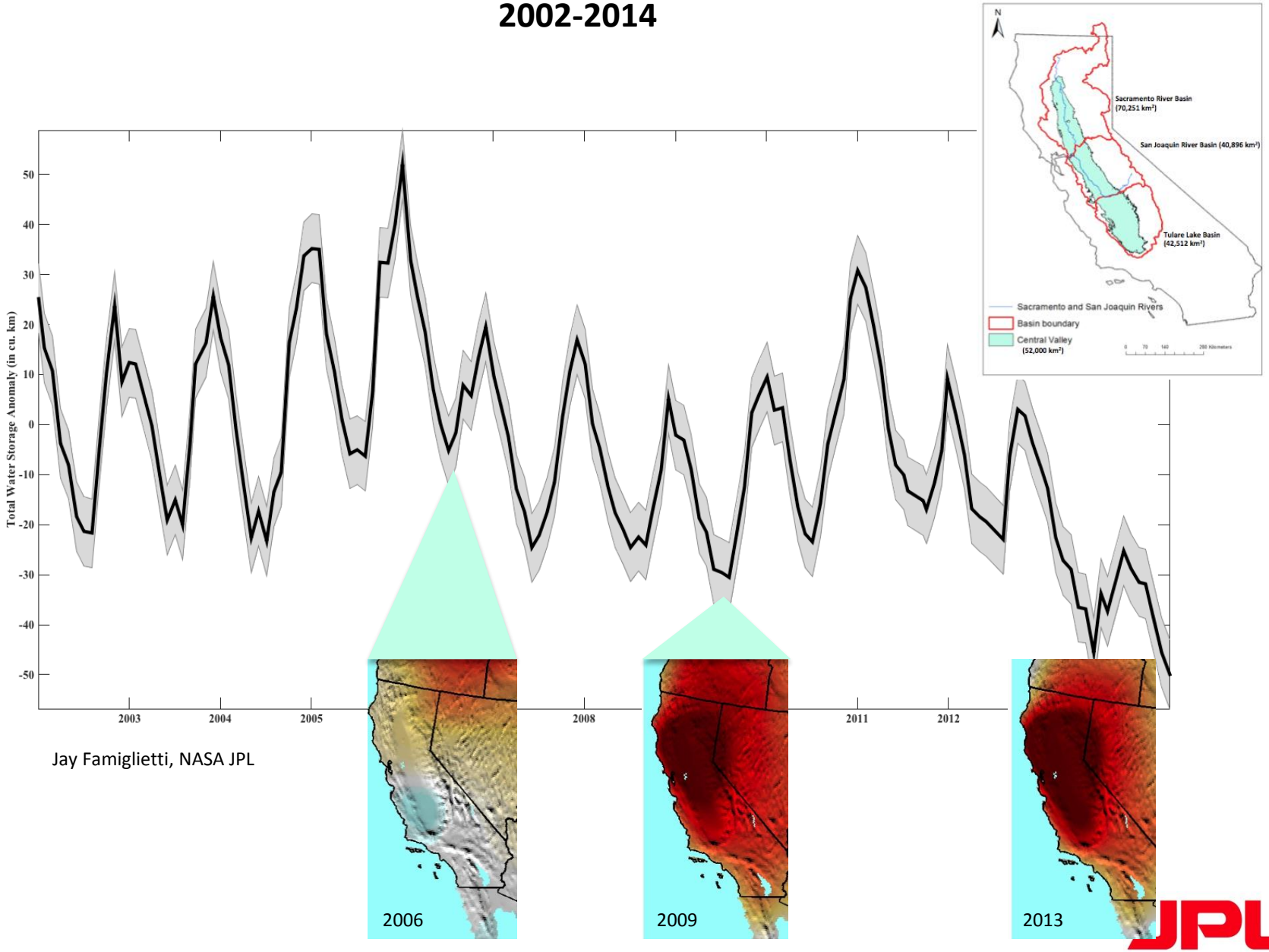
- Integrating NASA GRACE data into U.S. Drought Monitor provides new information on groundwater storage during drought
  - *reveals that groundwater levels across the southwestern U. S. rank in lowest 1% -10% since 1949.*

JPL

NASA Gravity Recovery and Climate Experiment (GRACE) Mission



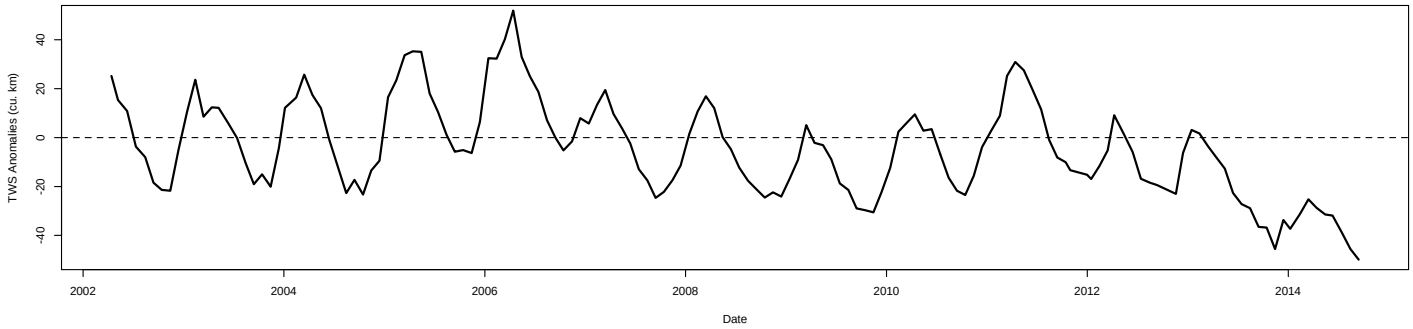
Change in total water storage in the Sacramento-San Joaquin River basins from GRACE 2002-2014



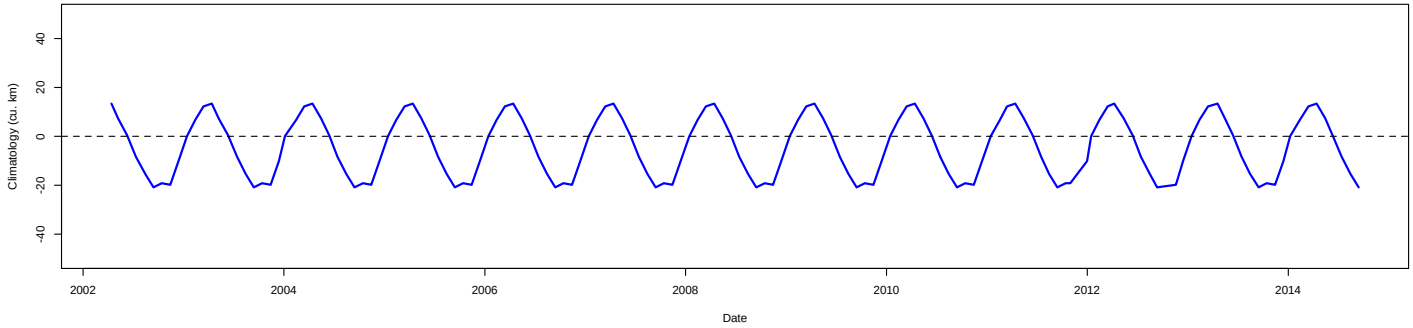
Jay Famiglietti, NASA JPL

Characterizing California drought with GRACE

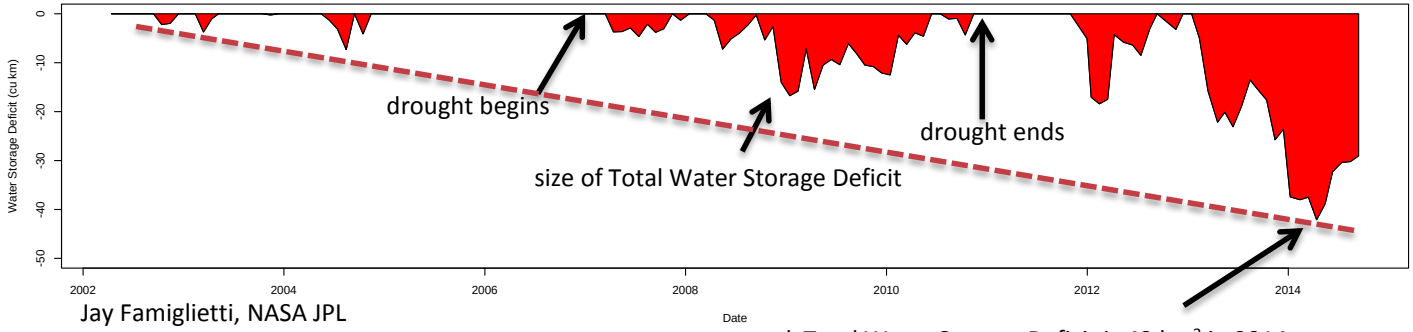
Actual monthly water storage variations



'Normal' range of monthly water storage variations

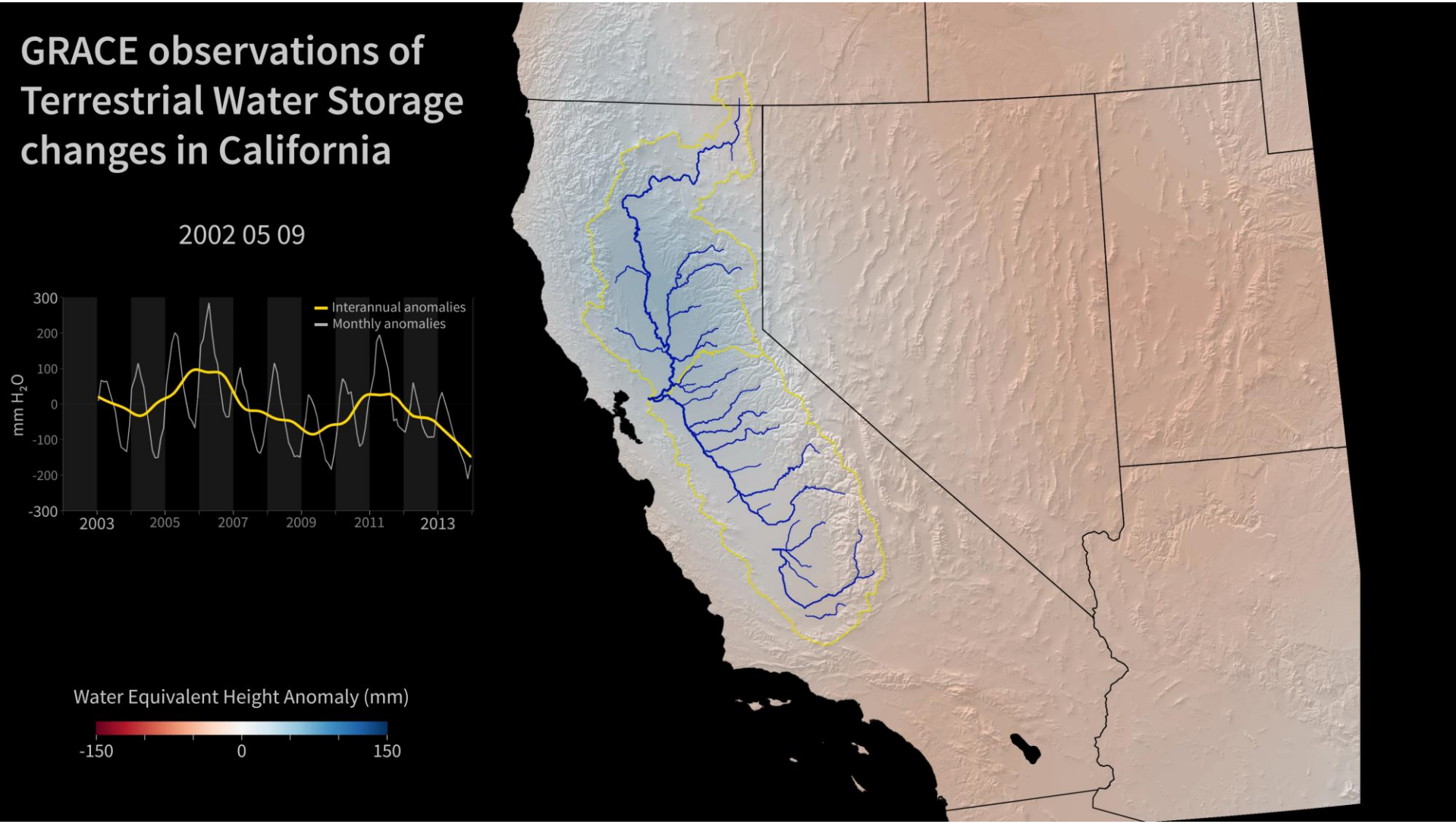


Differences from 'normal' dry conditions



Jay Famiglietti, NASA JPL

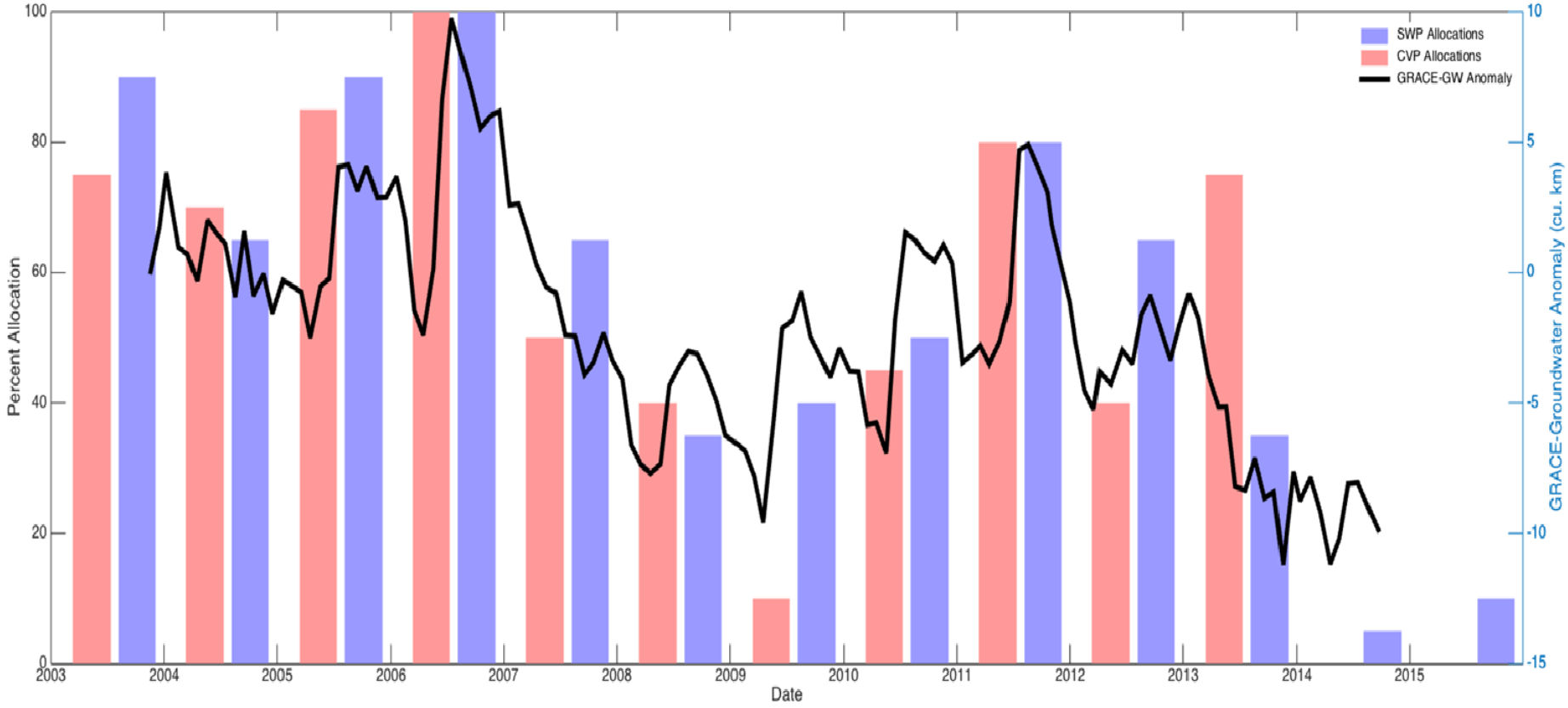
peak Total Water Storage Deficit is 42 km^3 in 2014



GRACE animation Jay Famiglietti, NASA JPL and NASA GSFC

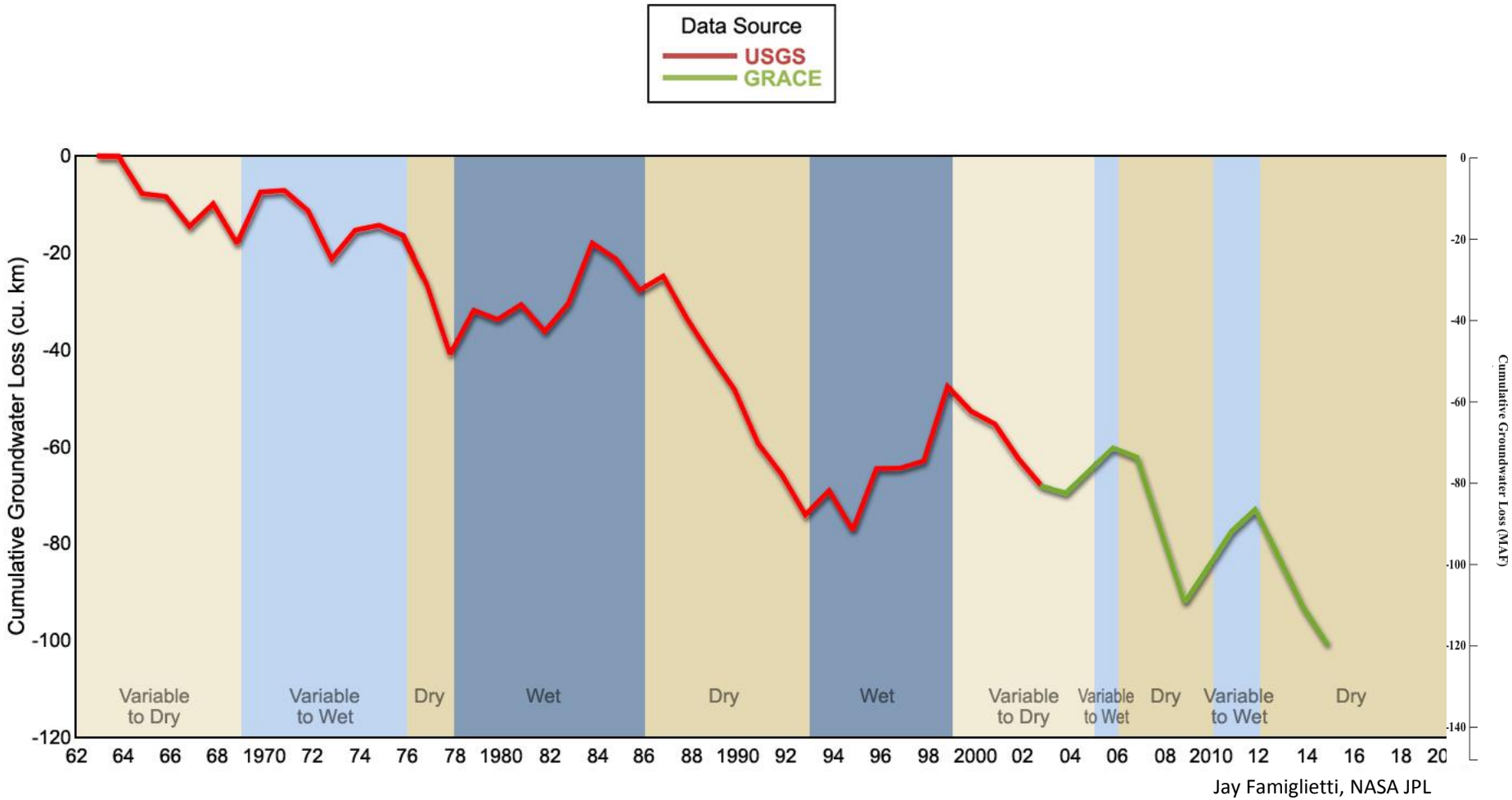
Central Valley groundwater depletion from GRACE(2003-2013)

Surface water allocations and groundwater use are closely connected



California's system of aqueducts for surface water redistribution

Cumulative groundwater depletion in California's Central Valley from USGS and GRACE



Jay Famiglietti, NASA JPL

Sierra Snowpack in 2014 Drought

Observations by Airborne Snow Observatory

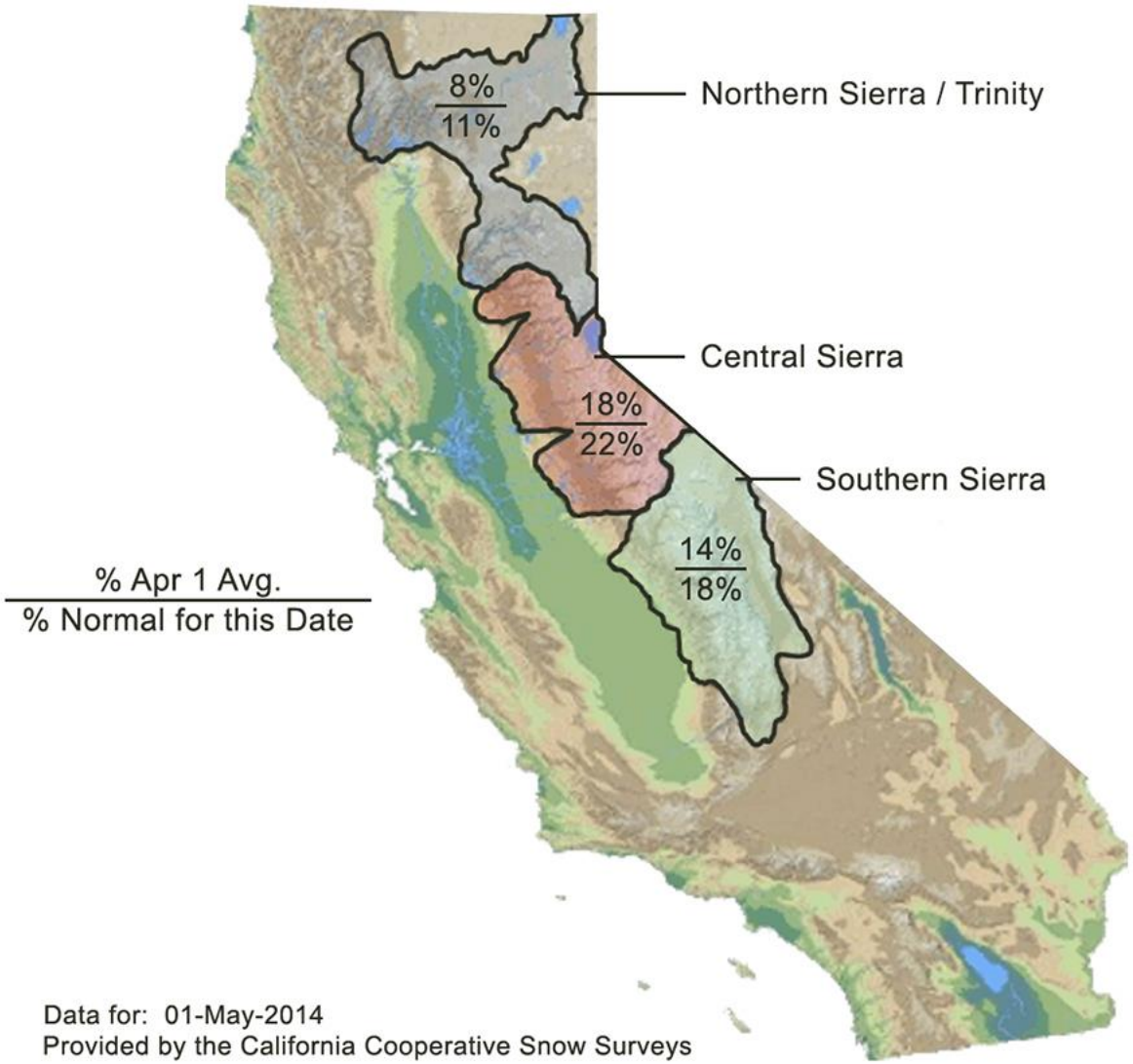
Jet Propulsion Laboratory
California Institute of Technology

Western Water Assessment

McGurk Hydrologic

NSIDC
National Snow and Ice Data Center

Snow Water Equivalents
(inches)



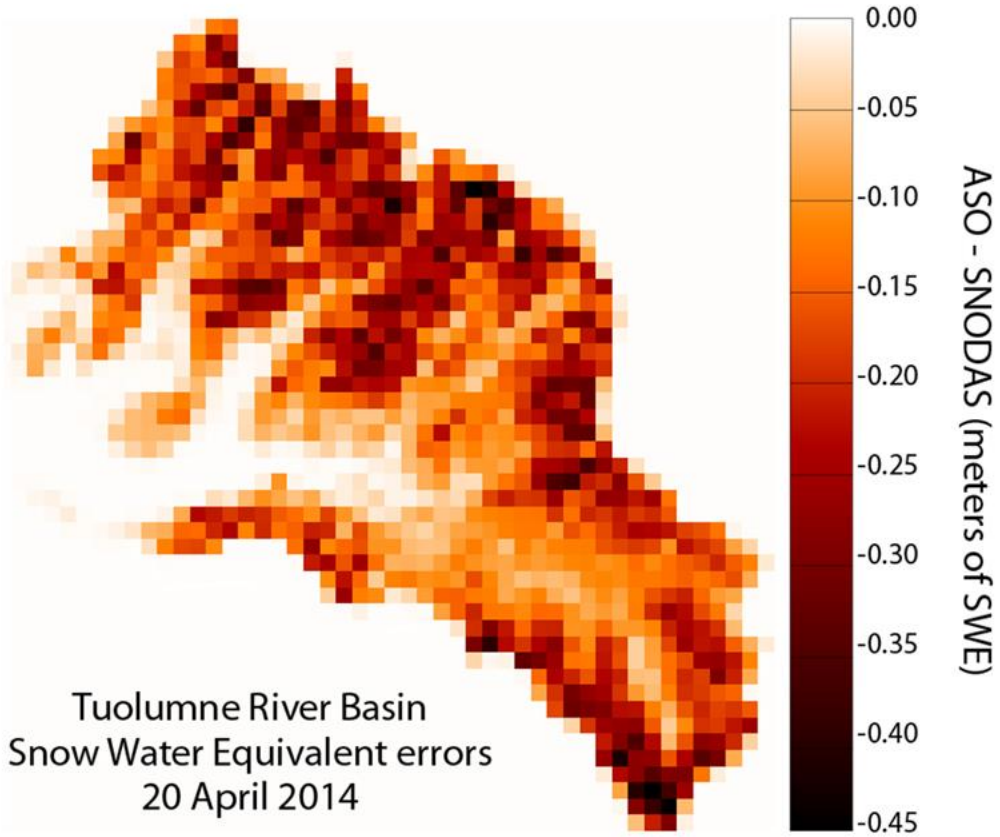
Less Accumulation ➔ Less Extent, More Warming

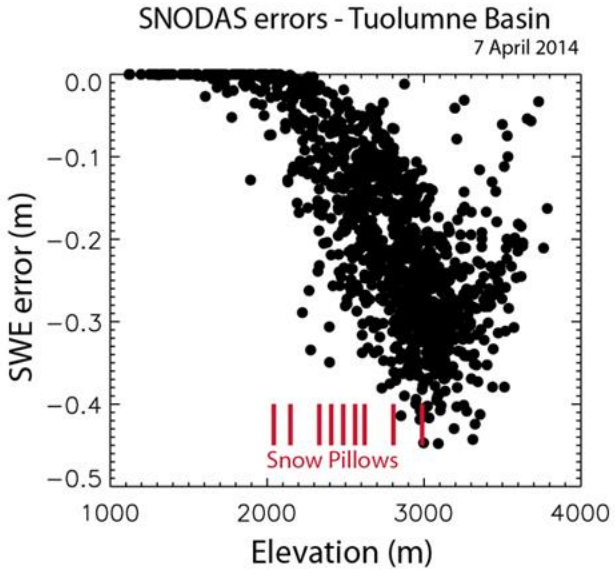
Tom Painter, NASA JPL

Mapping the Snow Water Equivalent with ASO

Tom Painter, NASA JPL

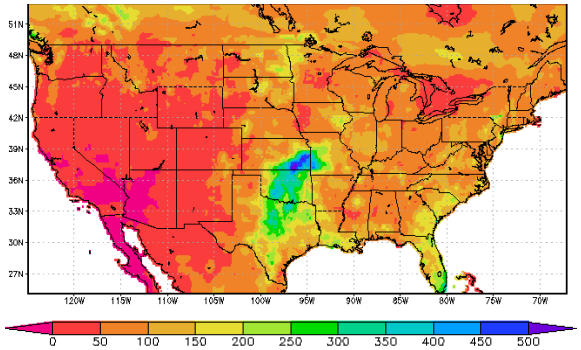
NASA ASO Shows Less Snow Than Thought



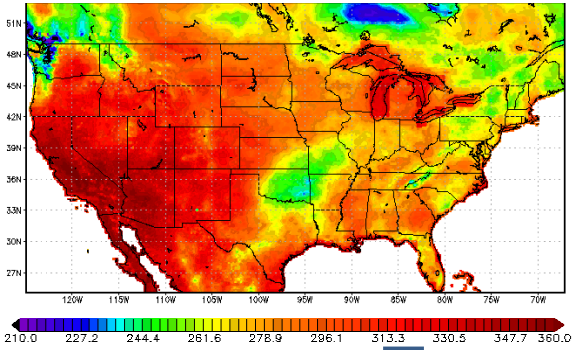


Integration of GRACE and other data

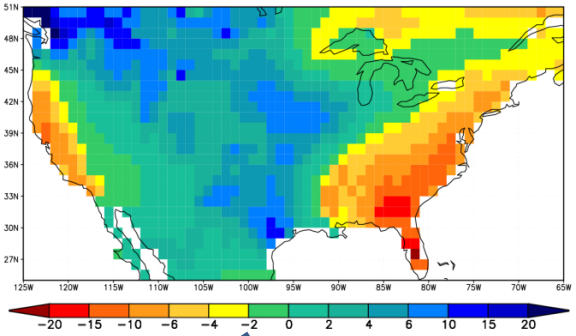
Precipitation (mm/month)



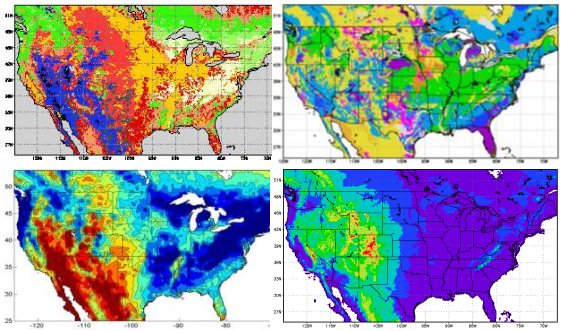
Solar Radiation (W/m2)

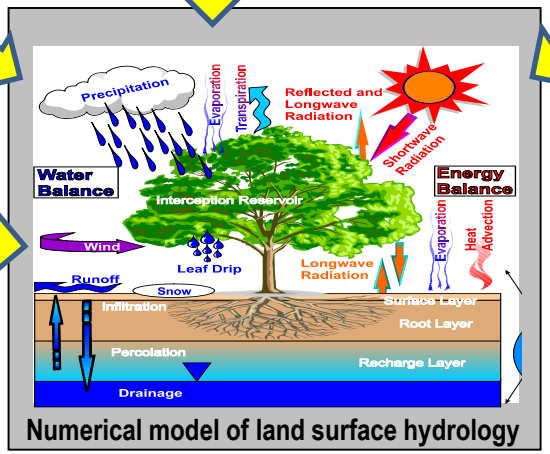


GRACE Water Storage Anomaly (cm)



Other land surface properties and meteorological variables



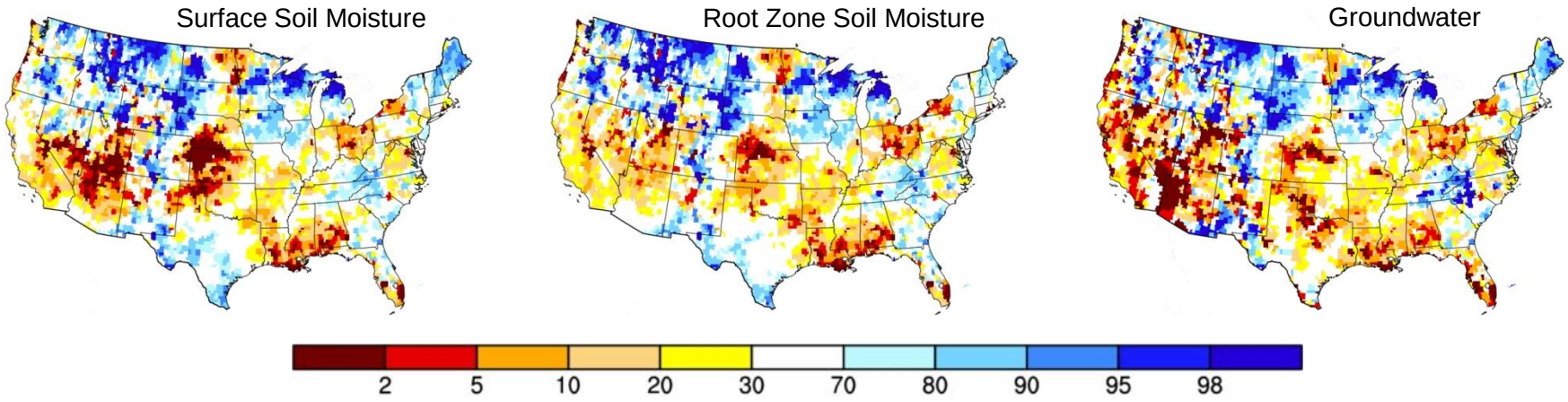


Matt Rodell, NASA GSFC

Integration of GRACE and other data

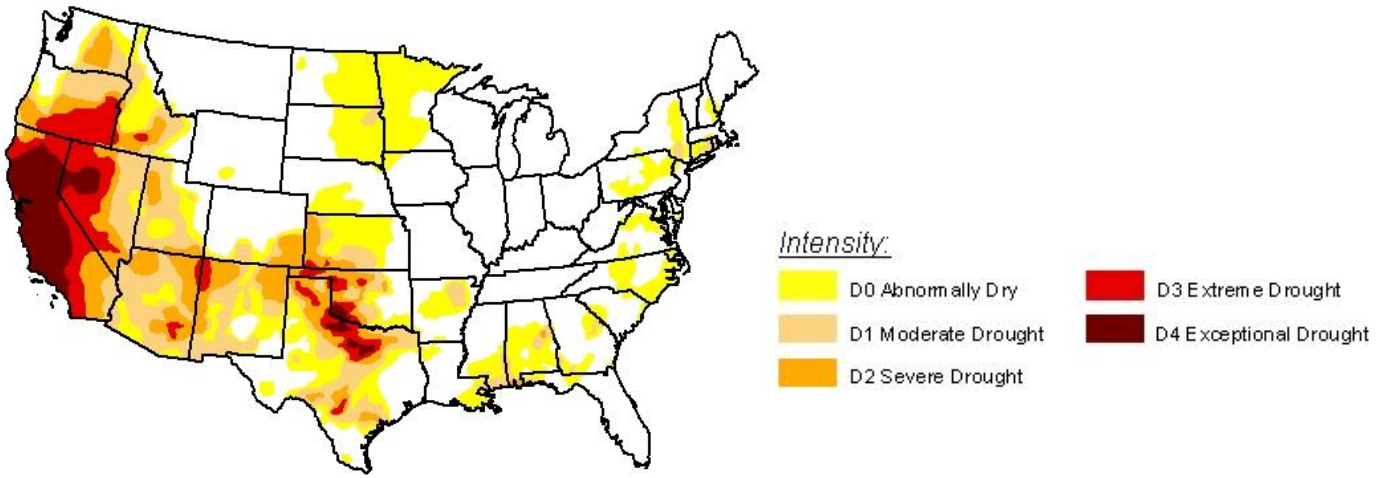
Drought indicators from GRACE data assimilation

December 1, 2014



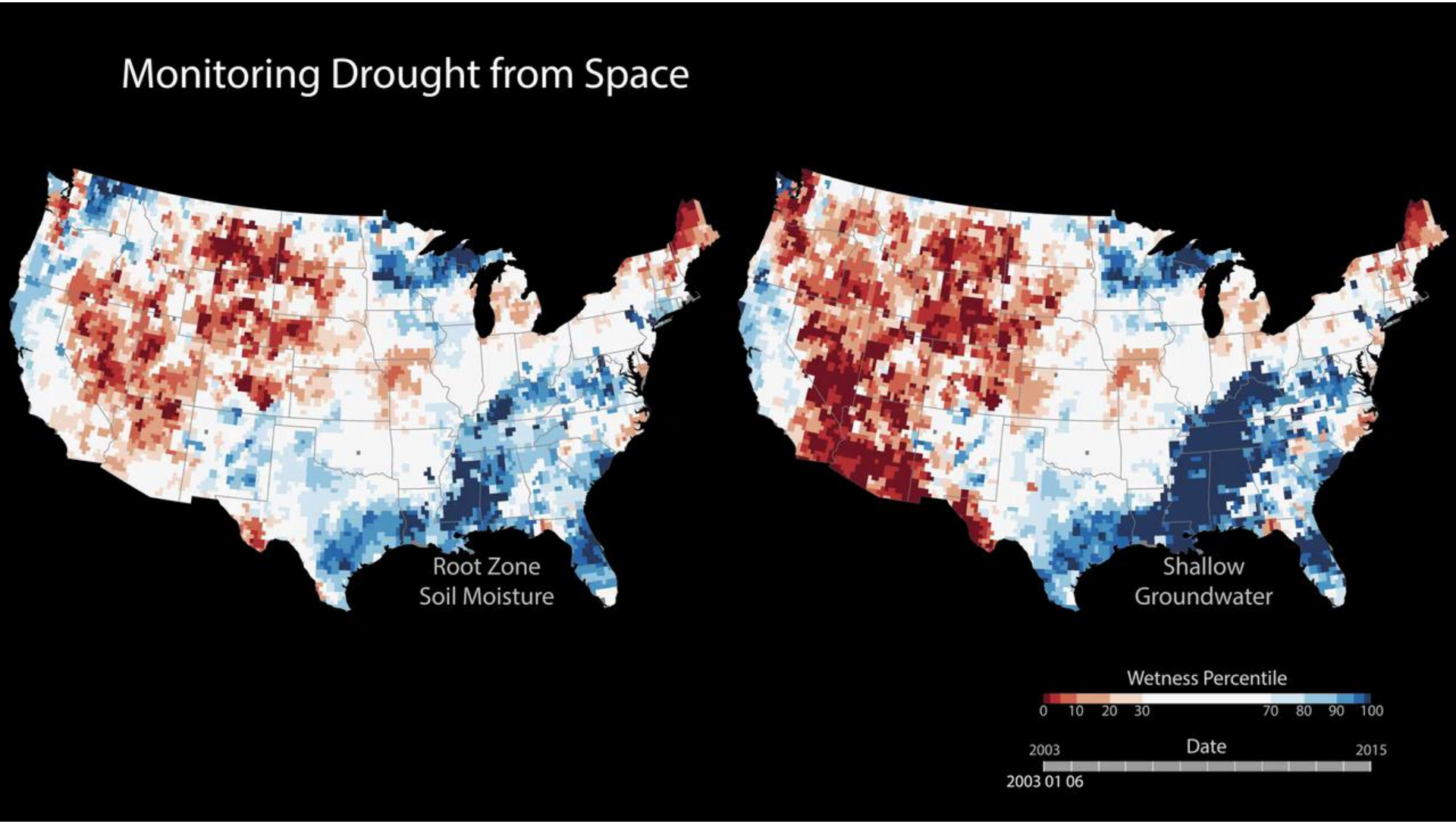
(wetness percentiles relative to the period 1948-present)

U.S. Drought Monitor product for December 2, 2014.

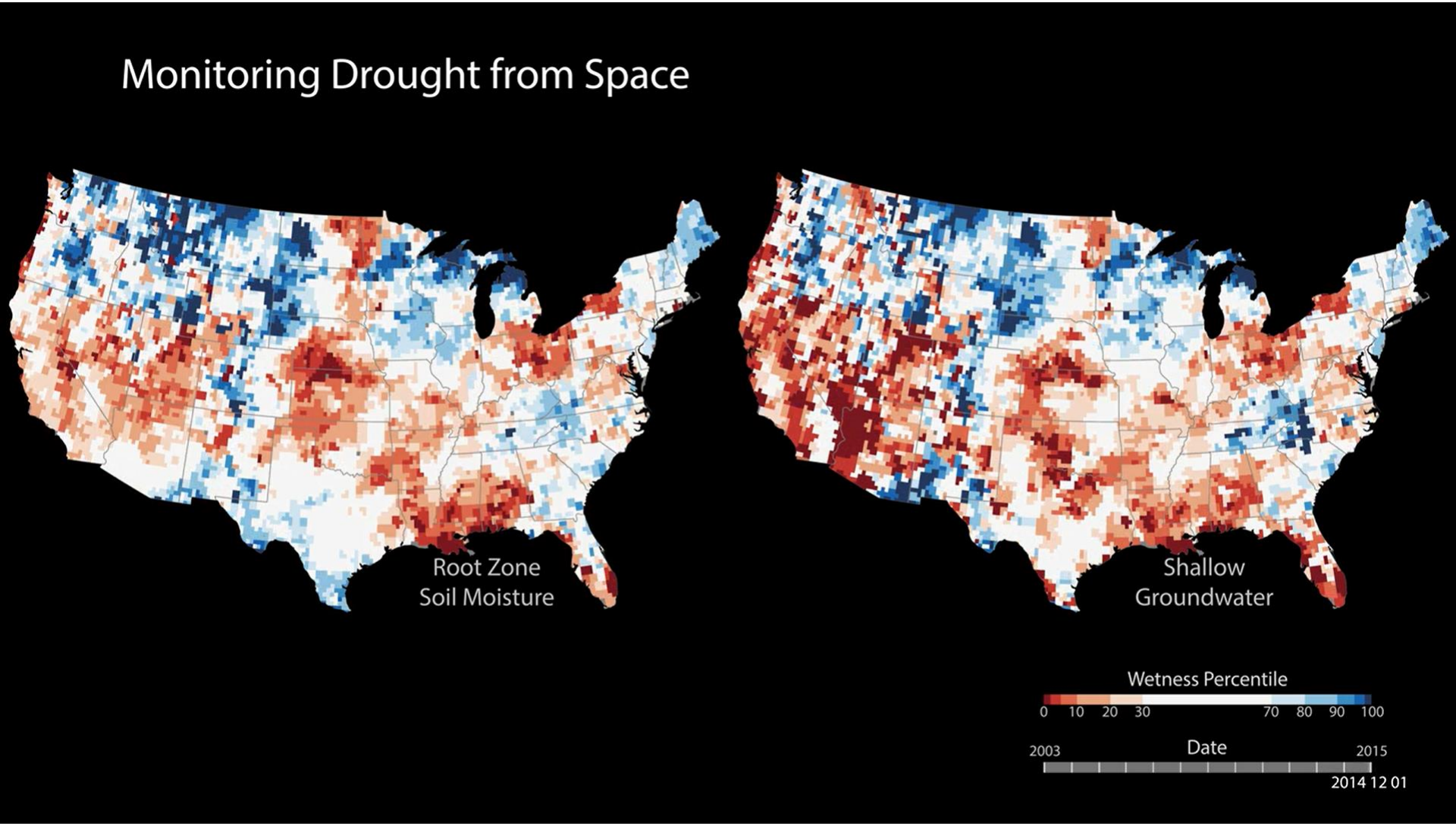


Matt Rodell, NASA GSFC

Indicators of drought based on GRACE data assimilation



Indicators of drought based on GRACE data assimilation



Matt Rodell, NASA GSFC